CROSS-REFERENCE TO OTHER PATENTS

The present application is related to my U.S. Patent 4,819,986 "Reclining chair with suspended seating"; my U.S. Patent 4,880,273 "Reclining chair having suspended seating", and my Canadian Patent 2,002,009 "Reclining chair having suspended seating". These being the only known patents that refer specifically to four legged or sled chairs having a spring-less reclinable seating .

BACKGROUND OF THE INVENTION

The applicant claim priority of Disclosure Document # 531771 dated May 22, 2003 plus the Provisional Patent Application # 60/485.067 filed 07/07/2003 .

In the patents mentioned above, the seating was supported by flexible members so as to enable it to rotate with respect to the chair frame, thereby enabling the user to vary his position from upright sitting to fully reclining sitting. A reclinable chair being more comfortable and healthier for its occupant.

Runners attached to the four corners of the seating board went through slots machined in the chair's frame whereby they attached to the ends of said flexible members. Each of the four slots where shaped like a circular sector, with the diameter of said sectors matching the distance between the front and the rear runners. Hence, the rotation of the seating was guided by the geometry of said slots. Expressly, the sliding of the runners over the edges of the slots controlled the motions of the seating.

Though the chairs having a suspended seating worked smoothly and effortlessly, the cumbersome mechanism and the aesthetic design constrains in the frame, needed to house said mechanism, were a big drawback. Another drawback was the impossibility to build an armless chair, since armrests were needed to house the mechanism, and used by the chair occupant to pull the seat forward from the reclined positions.

In the present invention - basically- the seat has plastic shoes or runners that slide over circular slots called here the raceways, that are attached to the frame. The sliding travel of the runners over the raceways defines the seat pivoting degree of rotation. Due to the nature of the sliding surfaces, all the motions are then smoothly and noiselessly attained.

But the most desirable characteristic of a non-powered reclinable seat should be its ability to rotate effortlessly over its whole arc of pivoting and to retain -also effortlessly- any attained seat position.

In the present invention this is achieved by the combination of two features:

a) By placing the center of rotation of the seat to the rear of the assumed center of gravity of the seat-occupant entirety, whenever the occupant tilts the seat back by pushing with his legs, it rises the center of gravity, hence, increasing the gravitational potential energy of the entirety. Thus, to bring the seat forward, the occupant just let go -intuitively- with his legs and gravity will bring the seat forward, effortlessly, up to its fully upright position, if wanted. And,

b) By making the resistance to rotate the seat proportional to the occupant weight, we achieve a reclining chair that is friendly to everybody. No more having a small person finding the seat hard to rotate, or a heavy set person – supposedly physically stronger- finding the seat to easy to rotate, hence, unstable.

In view of the innovative advantages mentioned above, it is the principal object of the present invention to offer a chair mechanism whereby the seat slides over curved surfaces.

It is a further object to provide an armless chair having a reclinable seat.

Yet another object of this invention is to provide greater aesthetics freedom of design, reliability and easy of manufacturing.

SUMMARY OF THE INVENTION

The above and other beneficial objects and advantages over the state of the art, are attained in accordance with the present invention which comprises a chair frame and a seat disposed within.

The seat is supported and guided by circular slots attached to the frame; corresponding runners attached to the seat enable it to slide over the convex , or the concave, surfaces of the raceways. In following the raceways path, the runners rotate the seat from a fully upright to a fully reclinable position, and to all positions in within.

In another embodiment the runners are attached to the frame and the raceways are attached to the seat.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a schematic perspective view of a chair with the seat in an upright position;

FIG. 2 is a schematic side elevation view of the chair shown in **FIG. 1**, with the seat in an upright position ;

FIG. 3 is a view similar to **FIG. 2**, but showing the seat in a fully reclined position;

FIG. 4 is an exploded perspective view of the chair shown in **FIG. 1**;

FIG. 5 is a view similar to **FIG. 2**, but illustrating the raceway in a different position;

FIG. 6 is a view similar to **FIG. 5**, showing the seat in a fully reclined position;

FIG. 7 is an exploded perspective view of the chair shown in **FIG. 5**;

FIG. 8 is a schematic perspective view of a chair in accordance with the preferred embodiment of the present invention;

FIG. 9 is a schematic side elevation view of the chair shown in **FIG. 8**, with the seat in the reclined position;

FIG. 10 is a side view of a chair similar to **FIG. 8**, but showing another embodiment of the present invention;

FIG. 11 is an exploded perspective view of the chair shown in **FIG. 8**;

FIG. 12 is a fragmentary sectional view taken along line D-D of **FIG. 9**;

FIG. 13 is a fragmentary sectional view taken along line D-D of **FIG. 9**, showing still another embodiment of the invention;

FIG. 14 is a schematic perspective view of a chair having a different embodiment of the present invention;

FIG. 15 is a schematic side elevational view of the chair of **FIG. 14**, showing the different positions of the seat-occupant entirety center of gravity when in its upright and reclined positions.

FIG. 16 is a fragmentary sectional view taken along line E-E of **FIG. 14**;

FIG. 17 is a fragmentary sectional view taken along line E-E of **FIG. 14**, illustrating one more embodiment of the invention;

FIG. 18 and **FIG. 19** are two different embodiments illustrating the front view of two different raceway inserts and their runners as seeing along line F-F of **FIG. 16**,

FIG. 20 is a side view taken along line G-G of the raceway shown in **FIG. 18**,

FIG. 21 is an exploded schematic perspective view of the chair shown in **FIG. 14**,

FIG. 22 is a schematic side elevational view along line H-H of **FIG. 21** .

FIG. 23 is a schematical cross section along line I-I of **FIG. 22**, and

FIG. 24 is another embodiment of the schematical cross section along line I-I of **FIG. 22**

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in detail to **FIG. 1**, a side chair using the present invention comprises a supporting wooden frame incorporating two similar side frames, each built to provide a substantially horizontal member **22** and substantially vertical leg members **20**. A front cross-rail **21**, and a rear cross-rail **29** connect both side frames.

It will be understood that the hardware is symmetrically disposed on both side of the chair; hence, the hardware on one side only will be described in the future.

The seat comprises an upholstered horizontal board **23** and an upholstered back board **26**, which are rigidly connected together to each other at an obtuse angle by the rails **25**.

This chair, having a reclinable seat, is built differently from the generic fixed chairs

where the seat structure and the frame are rigidly connected at a plurality of places. Here the seat rotates, or pivots, within the chair frame, whereby the seat and frame are connect only through the components of the invented reclinable mechanism.

Notice on the horizontal member **22**, a throughout machined circular ring sector **27** a slot called the raceway, that houses a corresponding male circular ring sector **28**, called the runner. While the raceway **27** is part of the chair frame, the runner **28** is part of the seat. The inner sector **28** having a shorter arc could travels -oscillate- between the inner ends of the raceway. This free travel - an arc of about 14° - clearly defines the extent of the seat rotation, tilting or pivoting.

FIG. 2 is a chair similar to **FIG. 1**, showing a side elevational view of the seat in a fully upright position. Here, the front end of the runner **28** rest against the front inner end of raceway **27**. The lower surface of the slot, also called the path because the runners always slide over that surface, is part of a circle having the same radio as the shown dashed lines circle with center on the cross-hair A.

The virtual (imaginary) transverse axis of the seat rotation would be a line passing through the cross-air A on both sides of the chair. The distance "**d** ", measured horizontally between a plumb line passing through the center of rotation A and the rear edge of the bottom board **23** is usually 4" to 8" (four to eight inches) , depending on the chair style and application. Since said center of gravity would vary widely, the value of "**d**" was settled after numerous diversified tests. In the present invention, the center of rotation is always (measured horizontally), behind the center of gravity of the seat-occupant entirety, to minimize the chair occupant effort necessary to tilt the seat forward.

To avoid that the seat tilts backwards due to the weight of the back board, a weak torsion spring **59**, connecting the side frame and the seat, will keep the seat in the upright position.

FIG. 3 is the same chair of **FIG. 2** showing the seat in a fully reclinable position.

Notice here that the runner **28** has rotated all the way back, inside the raceway **27**, until its rear end was stopped by the rear inner end of the raceway. **59** is the torsion spring.

FIG. 4 is a fragmentary exploded view of the chair of **FIG. 1.**

For clarity purposes only, the fabric and foam that comprises the upholstery horizontal board **23** has been removed, leaving in place an ubiquitous panel **24** that is the structural member of said board **23**. **28** are the runners (right and left hand required), rigidly attached to panel **24**. The runners could be made of a molded reinforced plastic, stamped out of a metallic sheet, machined from a cast or solid piece, etc. Or made by a combination of all of them. The matching cross section surfaces of the raceways and the runners are shown flat, but they could have other shapes. The raceway **27** that is shown here as a cutout on the wooden member **22** should have an inside plastic insert or metallic lining covering the wooden raceway surfaces. The insert or lining could be used to reinforce the wooden cutout, to reduce the sliding noise, to reduce wear and tear and/or to place small surface details on the raceways paths that would be impossible to duplicate in wood, etc.. In other instances, a lining that could be a plastic tape or a metallic strip, embedded, glued or fastened over the raceway paths could be used to change its operation, because the dynamic sliding of a runner over a raceway path is very much given by the coefficient of friction between their mating surfaces.

Here, numeral **59** are a pair of elastic elements, torsion springs in this case that, anchored to the planar board 24 and to the side frame in hole **60**, would force the seat against its upright position stops.

FIG. 5 shows a chair similar of the chair depicted in **FIG. 2**, but having the runner **30** sliding over a concave raceway **31**. In this layout the center of rotation is above the raceway, as shown by the cross-hair **B** .

The different placement of the center of rotation produce different motions on the seat. Other modes of seat rotation could be also created, if the raceway arc is not placed symmetrically to a plumb line passing through the center of rotation.

FIG. 6 shows the same chair shown in **FIG. 5** but with the seat fully reclined. Notice the different position of runner **31** inside the raceway **30**.

FIG. 7 is a fragmentary perspective exploded view of the chair of **FIG. 5.**
For clarity purposes only, the fabric and foam that comprises the horizontal board **23** has been removed, leaving in place an ubiquitous panel **24** that is the structural member of said board **23**.
30 are the runners, rigidly attached to panel **24**. Numeral **31** are the raceways.

FIG. 8 chair shows the preferred embodiment of the present invention where the raceways and runners sliding surfaces had been substantially reduced in size .
Here, the raceway with a large arc, like e.g.: raceway **27** of **FIG. 2** has been sliced and only the end parts of it are used, scraping the middle section. The two new smaller circular ring sectors **32** and **35** continue sharing the same diameter circle.
The runners **33** and **34** are the free ends of small diameter shafts (about .375" O.D.), but still rotating the same degree of arc than in previous chairs.
This plurality of smaller raceways and runners is ideal for inexpensive, small tube frames and/or expendable chairs, where space for the reclining mechanism components is always tight, and a shorter useful life is acceptable. Also, though the larger surfaces in contact of the runners and raceways of **FIG. 2** and **FIG. 5** make for a smoother pivoting seat, they do require very sturdy chair frames, since the right and left raceway-runner engagement have to share the same virtual axis of rotation, during the whole life of the chair. There is very little tolerance for misalignment before the runners will drag excessively and/or lock up in their raceways.
Instead, in the new embodiment, the runners, each having only a small surface of contact with their raceways, are more tolerant to some misalignment within the components.
Moreover, the raceways don't have to be perfectly circular any longer, since a system of two runners per side will always follow any curved path. For example, the raceways could now be: slightly elliptical or parabolic in its totality or at certain spots; it could even have straight sections, or the original circular path could become distorted by usage without loosing its functionality.
Though the illustration shows the raceways placed above their common center of rotation, all of above claims would also be valid if we had placed the raceways inverted,

e.g. below their center of rotation, like shown in **FIG. 5**, **Fig. 6** and **FIG. 7**.

FIG. 9 is a side view of the chair shown in **FIG. 8**. Here the seat is shown in the fully reclined position. Notice the position of the front runner **33** at the top of the raceway **32**, while in the rear raceway **35**, the runner **34** has moved to the lower end of the raceway. The cross-hair **C** is the virtual center of rotation of the seat.

Here, β is the angle between the center of the runner **33** and a vertical line passing through **C**, while α is the angle between the center of the runner **34** and the vertical line passing through **C**. In this illustration de value of β is 48°, and the value of α is 60°.

Since the raceways **32** and **35** are placed symmetrically to a vertical line passing through the cross-hair **C**, the 12° difference between the α and β angles is the pivoting arc of the seat. Larger α and β angles increases the friction between the runners and their raceways. Though I have shown the raceways placed symmetrically to a plumb line passing through their center of rotation **C**, different seat requirement and the chair aesthetics may benefit from non symmetrical angular and radial placement of the raceways.

Obviously, different placement of the raceways will alter the friction factor, hence, the force required to rotate the seat between the upright and the reclined positions, and the ability of the seat to remain 'locked' in a chosen place .

FIG. 10 is a side view of a chair similar to the chair shown in **FIG. 8**, with the seat in a fully upright position. The structural panel **24**, shown in slashed lines, is part of the horizontal upholstered board **23** .

In this embodiment the runners **33** and **34** are riding over the outer (lower) concave path of the raceways. The center of rotation of these raceways is indicated by the cross hair **L**, located above them.

Moreover, the front raceway **59** and the rear raceway **60** are placed asymmetrically with respect to a plumb line passing through **L**, besides being placed on two different concentric diameter circles.

FIG. 11 is a schematic exploded view of the chair of **FIG. 8** .
Here **42** is a foam block, part of the upholstered horizontal board **23**. **26** is the back upholstered board, firmly attached to the structural panel **24** by the two rails **25**.
33 and **34** are two round shafts firmly attached to the panel **24** by straps **48.** The ends of these shafts function as runners that will slide inside the raceways **32, 35, 36** and **37**.

FIG. 12 is a cross section showing some interesting details of the raceway-runner assembly. For clarity purposes the cloth covering the horizontal board **23** is not shown. Numeral **22** is the horizontal member of the chair's frame. Fastened, glued or press fitted into the open cutout **32** is an insert **38** made of plastic or metal. At the end of shaft **33**, a free rotating wheel **39** -like a follower cam- rolls inside said insert **38**.
A raceway lip **57**, a flange on the wheel **39**, plus a shoulder step on the shaft diameter checks any lateral seat motions. **48** is a clamp that attach shaft **33** to the seat panel **24**.
42 is the horizontal board foam.

FIG. 13 is another embodiment of the invention. Here, for aesthetic reasons, the raceway cutout is open only to the inside of the chair. The insert **40** is placed firmly into the closed end raceway cutout in member **22**. **41** is a rotary plastic cap mounted on the end of shaft **33.** The bottom wall of insert **40** and the bottom wall of cap **41** limit any lateral motion of the shaft **33**, and by extension, any lateral motions of the seat on the frame, since the shaft **33** is firmly attached to the seat panel **24**, by the straps **48**.

The chair of **FIG. 14** shows yet another embodiment of the present invention, more applicable to tubular frame chairs having rest arms. Here **43** and **44** are two identical U shaped side frames, securely spaced apart by a front cross rail **45** and a rear cross rail **46**.
The seat comprises an upholstered horizontal board **23** and an upholstered back board **26,** which are rigidly connected together to each other at an obtuse angle by the rails **25**.
Numeral **47** is a rectangular tubular member -housing the reclining mechanism- securely attached to the vertical members of the side frame **43**.

FIG. 15 illustrates the two extreme positions that a chair occupant could attain. The human silhouette sitting in an upright position was drawn in a heavier line weight than the same human silhouette sitting in a fully reclined position. The reclining angle was 12°, and the center of the seat pivoting was at the cross-hair **G** .

In any non motorized reclining chair, the occupant uses his legs and/or hands to change the seat position. In the most ubiquitous of the reclining chairs: the office task chairs, the chair occupant compresses a spring when he pushes the seat backwards with his legs.

The seat will remain reclined as long as the occupant keeps the spring compressed. When the occupant relaxes the pressure that he puts on the seat back board, the seat rotates forward to its upright position.

In the present invention, when the occupant pushes with his legs against the chair vertical back board, the whole seat reclines backwards while the center of gravity of the seat-occupant entirety system rises. This increase in potential energy of the system, will allow gravity, all by itself, to bring the seat forward when the occupant relaxes his push.

Here, **FIG. 15** illustrates the rise of said center of gravity; say point **J** for the upright seating silhouette, to a higher point **K** in space, for the reclined silhouette. Points **J** and **K** are -in this illustration- at the intersection of the figures chest and arm lines. Notice that point **K** would still be forward of a plumb line (not shown for clarity reasons), passing through the pivot center **G**. If point **K** where to fall behind said imaginary plumb line, the only way that the occupant could rotate the seat forward, would be by grabbing the armrest and pulling the center of gravity forward, at least until said center of gravity passes forward of said plumb line. From there, once again, the forces of gravity should bring him all the way forward, up to the fully upright seat position.

By introducing a friction factor between the raceways and the runners, we increase the acceptable effort that an occupant has to apply to recline the seat. But this friction, acting as a brake, is a must for slowing the forces of gravity that want to bring the seat forward (toward the upright position). By having the friction slowing the seat motions, the occupant may chose any forward reclining position by just releasing the pressure that he exerts against the back seat, and the seat will slowly rotate forward. The friction will also make it easier to keep a balanced seat 'locked' in place

In the present invention the friction coefficients would vary with the materials used to manufacture the raceways and the runners, while different shapes and position of these runners and raceways, by exerting different forces -for the same occupant weight- over the sliding surfaces will require different amounts of efforts to pivot the seat.

If we didn't introduce a reasonably friction factor, like if the seat rotated with an extremely low friction around a ball bearing guided shaft, the seat positions would be extremely unstable, and the chair useless.

In **FIG. 16**, **33** is a shaft fastened to the panel **24** by strap **48**; attached to he end of the shaft **33** we have a free rotating wheel **39**. Panel **24** is part of the horizontal board **23**. The plastic insert **49** is the raceway, snapped into a corresponding hole machined on one side of the tubular member **47**. On its travels, the free wheel **39** follows the inside shape of the raceway, thus tilting the attached seat accordingly.

FIG. 17 shows still another embodiment of the present invention. In this embodiment the raceways are placed on a pivoting seat, while the runners are welded to elements of the static chair frame.

Here, the raceway, represented by the plastic or metal insert **51** is glued to the wooden block **50**, that in turn is glued to the seat panel **24**. The runner **53** is a stud welded to the frame member **47**. **52** is a plastic cap covering the stud's end.

In this embodiment the runners remain fixed while the raceways slide over them.

FIG. 18 is a front view of the plastic raceway **49**. It is shaped like a circular ring sector with fully rounded ends. The dashed circle lines inside the raceway indicates the two extreme locations of the wheel **39**.

Since a reclinable seat is always back heavy, an unoccupied seat may slowly creep backward, or the seat wouldn't stay in the upright position when the chair is moved around. This could be avoided by using a spring, as shown in prior **FIG. 2**, **FIG. 3, FIG. 4** and **FIG. 22**. In a novel embodiment of this invention, this undesirable back rotation

could also be corrected by molding a plurality of ridges or detents **53** inside the raceway **49** upper and lower paths. This round ridges – only a few thousands of an inch high- will stop the wheel **39** from creeping out of its bottom location. The ridges would also lessen the slamming of the runners against the raceway bottom when the seat reaches its upright position. In another instance, the detents could be replaced by a narrowing of the raceways aperture, that would create an interference with the runners, slowing the runners down, and keeping them in place. Then, only the chair occupant effort will snap the wheel out from its bottom location.
The long dashed lines **56** indicates the raceway wall thickness.

FIG. 19 shows still another embodiment of a plastic raceway. It is similar to the raceway **49** of **FIG. 18**, showing a plurality of ridges **58** on the raceway path. To assure a stronger retention of the front runner **54** -when at the bottom of the raceway- said runner has incorporated minute matching ridges. Here, the circular dashed lines **33** is the free end of the shaft, and the elongated shape represented by numeral **54** is a cap covering said shaft end. The adoption of an elongated shaped runner, while not as smooth going as a rolling wheel, would handle larger seat loads due to its larger foot print.

Intermittently in the past, I meant –liberally- by a runner: the ends of a rod or a plastic piece that rolls, slides, coast or glides inside a raceway.

FIG. 20 is a side view of **FIG. 19** showing how the elastic barbs **55** (molded onto the outer wall of the raceway insert), engages the walls of member **47** (shown here in phantom lines). The wall gets clamped within the flat back of the raceway lip **57** and a plurality of barbs **55,** keeping the insert firmly in place.

An alternate embodiment of this invention is illustrated in **FIG. 21**, an exploded partial view of the chair shown in **FIG. 14**. Here, the raceway **61** is a metallic or plastic circular segment attached to the inside of the horizontal member **47**, a U type metallic channel. **62** and **63** are the front and rear plastic runners respectively for each side;

these runners are loosely mounted on the flanges or prongs **66** of bracket **65** that is fastened to the horizontal board **24**. Bracket **65**, a stamped steel piece, has a plurality of flanges or prongs **66** that engage the runners through corresponding openings in one side of the runners. In this illustration each bracket has two runners, but it could have more if the raceway path is too narrow and the load on the runners become too heavy. The middle prong, numeral **70,** has a small hole where an elastic element, in this case a tension spring **67** –only on one side shown- engaged at one end to said prong and at the other end to the anchor **68**, attached to the inside of channel **47**. The function of this spring is to keep the seat in an upright position. Without the spring, since the back board of the seats are usually quite heavy, the seats could creep into an unsightly reclined position.

In an assembled mechanism the cover plate **69** is fastened to the raceway **61** by means of screws that, due to their small sizes are not shown.

Here, **71** are clearance holes for the screws and **72** are the threaded holes used for fastening the cover plate **69** to the raceway **61**.

The functions of the cover plate **69** are multiple. It covers the components of the mechanism, hence, is a decorative piece. It also keeps the chair occupant's fingers out of harms ways, since the mechanism has pinching points. But a more important function would be to check the motions of the runners. In the present illustration, the openings **74** and **75** are slots concentric with the raceway(s), and having well defined ends. Its obvious that both ends of each slot could be used to stop the rotation or tilting of a smug fitting runner -and by extension since the runners are part of the seat- be the seat stops at the upright and at the fully reclined positions -in addition of other seat stops- as could be the case of the front runner **62** in the opening **74** in this illustration. In this embodiment, the cover plate **69** also checks the upward motions of the runners, since raceway **61** only has the lower path. Numeral **76** is the cover plate opening for the prong **70**. The horizontal member **47** could also have been a carved wooden piece, instead of a metallic piece, if it was considered strong enough for the application.

In **FIG. 22**, a partial schematic side view , shows the location and motions of the runners and spring in an assembled reclining mechanism for this embodiment, with the cover plate **69** removed for clarity purposes only. The position of the corresponding bracket prongs are indicated by the side openings on the runners and by the spring hook.

Numeral **61** is the raceway represented by the convex arc of a circular segment fastened to the horizontal member **47** by screws **73**. **62** and **63** are the front and rear runners respectively, sliding over the arc of the raceway **61**. Up to now, the upper and lower paths of all the raceways were done into one piece, but in this embodiment they are found in two different pieces. The lower path is provided by the arc of the circular segment **61**, that we will keep calling the raceway, and the upper path(s) are provided by the upper edges of the cover plate **69** openings that are circular rings sectors concentric with the raceway.

Here, the rectangles **66** would be the position of the prongs in the assembled mechanism. **67** is an elastic elements, e.g.: a tension spring engaging at one end the prong **70** and at the other end to the anchor **68**. **72** are threaded holes used to fastening the cover plate **69**.

This would be the position of the runners, prongs and spring when the seat is at the upright position. Notice here that the front runner **62** is stopped here by the inside face of the lower leg or flange of the channel **47** .

Stopping the runners, or the prongs, would stop the further rotation of the seat.

In other embodiments the stops could be part of the raceway **61** or the cover plate **69** .

When the seat rotates or tilts backward, the runners **62** and **63** slide backward over the raceway **61**, to their reclined position shown here by the phantom lines of **62a** and **63a** respectively. **66a** would be the new positions of the prongs **66**. Likewise, the spring **67** is stretched to the new position **70a** (shown in phantom lines), of the prong **70**.

Notice that when the rear runner **63** reaches its **63a** position it is stop from further traveling by its interfering with the lower flange of the channel **47**, thus becoming the farther reclined position attainable by the seat.

In prior embodiments the runners were housed in slots that limited their vertical displacements. In normal operation the runners are only in sliding contact with the

lower path of the raceway because the weight of the seat-occupant entirety forces always the runners downward. But it may happen when the seat is at one of the extreme positions: upright or fully reclined, that, if the chair occupant forced the seat against its stops, some runners will be forced against the upper paths of the slot . Another instance would be when the chair is lifted by the seat, pressing all the runners against the upper path of the raceways. But these vertical motions occur only in very rare circumstances, and in none of them the runners slide over the upper path of the slots. That's why in the embodiment shown in **FIG. 21** and **FIG. 22** the raceways could have only a lower path. For the very rare occasions where vertical motions of the runners have to be checked, a thin slotted cover plate **69** , limiting the upward motions of the runners or their prongs, would suffice.

In **FIG 23**, the phantom lines illustrates the position of the cover plate **69** in an assembled unit. Here the runner **63** extends horizontally past the corresponding opening **75** of the cover. While the runner rides over the raceway **61** that would stop any downward runner motion, any runner upward motions would be checked by the upper edge of the opening **75** of the cover plate **69**. The position of the prong **66** of the bracket **65** are shown here in phantom lines.

In some instances were the load on the runners is low, like in some child chairs, given enough cover plate thickness, the raceway could be eliminated and the openings or slots in the cover plates **69** becomes the raceway with its lower and upper path, and the ends of the slot becoming the upright and reclining seat stops. In this possible embodiment, the cover plate would be directly attached to the channel **47** as an insert .

In another embodiment of the cover plate **69**, as shown in **FIG. 24**, the runner **63** has the same width as the raceway **61**. While the runner rides over the raceway **61** that would stop any downward runner motion, any upward motion of the runner **63** would be checked by limiting the upward motion of the corresponding prong **66** of bracket **65**, shown in phantom lines. To that effect, the opening **75** on the cover plate **69** is just a little wider than the prong's **66** material thickness.

While the invention has been described with respect to a preferred embodiment, it is apparent that various changes can be made without departing from the scoop and teachings of the invention as defined by the appended claims.

What is claimed is:

1. A reclining chair comprising:
a structure having two supporting side frames, each having at least one substantially horizontal member and substantially vertical members, said frames disposed in a spaced apart relationship by cross rails;
a seat disposed within said frames further comprising a bottom board and a back board connected together; and,
means for supporting said seat including (1) a plurality of concentric circular ring sector shaped slots located on said horizontal members further defining the virtual axis of rotation and the stops of said seat thereto said side frames and (2) a plurality of plastic runners attached to said bottom board and sliding therein said slots.

2. A chair as on claim 1 whereby the virtual transverse axis of rotation is horizontally located four to eight inches forward of the rear edge of said seat bottom board .

3. A chair as described in claims 1 whereby the runners are wheels;

4. A chair as described in claims 1 whereby the circular ring sector slots are placed into inserts;